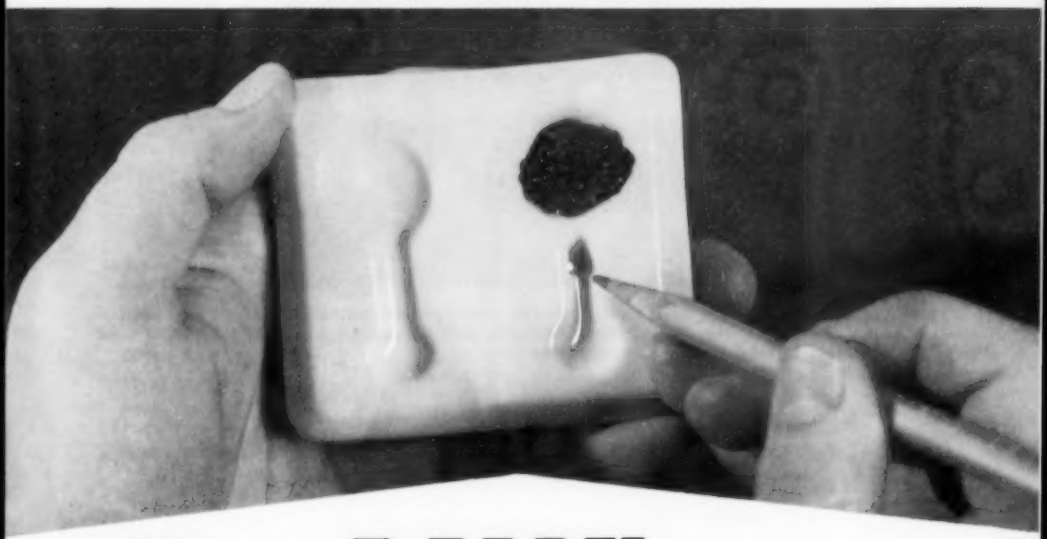
CORNELL EXTENSION BULLETIN 822



More LIME *on your land*

Samuel R. Aldrich, Department of Agronomy

PROBABLY some or all of your fields need more lime. Few farmers try to farm acid soils without lime, but many use 1 ton where 2 are needed, or 2 tons where 4 are needed.

Do you know the pH (page 3) of every field on your farm? Do you know how much lime you need to raise each field to the pH where farming is most profitable? You don't need to continue to wonder what the answers to these questions are. Test your fields! To help you, the Department of Agronomy has developed the *Cornell pH Test Kit For Lime Requirement.* Other suitable tests for lime need are available, but this kit is especially packaged for use right in the field.

Tests on hundreds of soil samples from general farms made in the Soil Testing Laboratory at Cornell show that about 26 per cent are strongly acid and another 35 per cent are moderately acid. These fields are not growing the crop yields that they should.

County agricultural agents who have tested soils in the same county for more than 20 years say that few farmers have used enough lime to raise the pH of their farm soil. Most have barely replaced the lime that has been lost through cropping and leaching.

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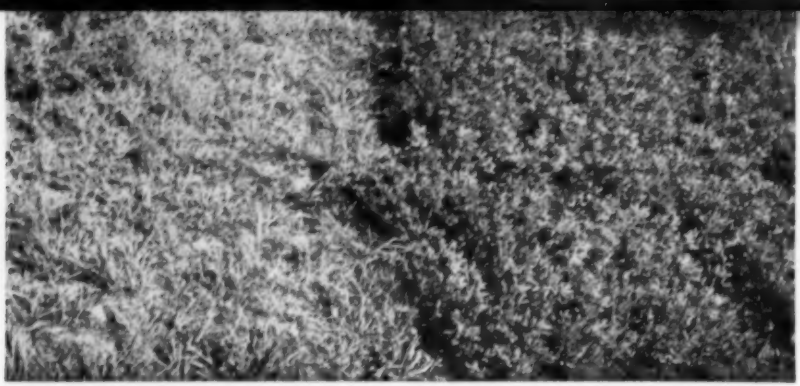

Figure 1. Both plots were well fertilized with phosphorus and potassium, and seeded to the best varieties. The only difference is that the one on the right received 2 tons of lime, while the other was not limed.

Costs and Returns

A SUITABLE pH (page 3) is a necessity if you are to get efficient use of fertilizer, as well as a return from your labor and investment in machinery and livestock (figure 1).

No farmer can prosper in dairying on an acid farm. The use of half enough lime may permit a profit when things are good, but the farm will go in the red when prices sag.

In terms of costs and returns, lime is the best investment you can make if your fields are acid. In recent years the cost of lime has gone up less than any other production cost. Fertilizer is a close second. The trend in prices of labor, farm machinery, feed, and fertilizer and lime since 1925 is shown in figure 2.

Looking at it another way, your can of milk will buy about 30 per cent *less labor* and 15 per cent *less machinery*, but 50 per cent *more lime*, than in 1940.

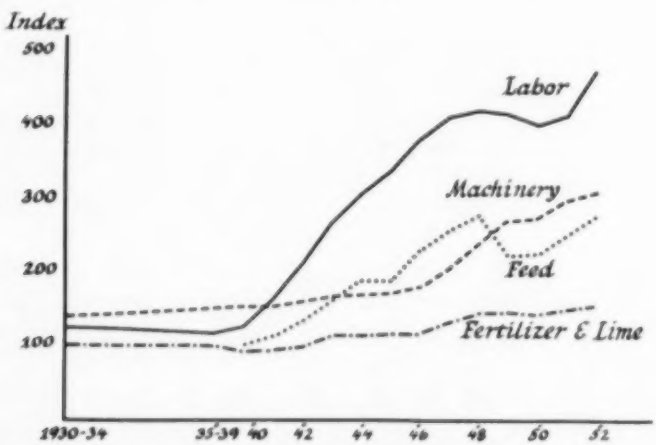

Figure 2. Relative cost of labor, machinery, feed, fertilizer, and lime, 1930 to 1952 (1910-1914=100)

In spite of the favorable price for lime, *New York farmers are spending about $8 for fertilizer and $40 for feed to each $1 spent for lime.*

How Much Lime to Use

SOILS vary in the amount of lime needed to change the pH a given amount. A clay loam may require four times as much as a sand, with a silt loam intermediate, as shown in table 1.

Table 1. Tons of Lime Required to Raise the pH of the Plow Layer to 6.5

Soil texture		Degree of acidity		
		Slight 6.1 to 6.4	Moderate 5.6 to 6.0	Strong 5.5 or below
Coarse	sands sandy loams	½ to 1	1 to 2	2 to 3
Medium	loams silt loams	1 to 2	2 to 3	3 to 6
Fine	silty clay loams clay loams	2 to 3	3 to 4	4 to 10

pH is the term used to describe soil acidity. New York surface soils can be classed as follows:

pH 6.6 to 7.0—near neutral
pH 6.1 to 6.5—slightly acid
pH 5.6 to 6.0—moderately acid
pH 5.5 or below—strongly acid

To do the best job of farming, the entire furrow slice or plow layer should be limed to above a pH of 6.5 for rotations that include alfalfa and sweet clover and above 6.0 for other field crops. Where this requires a very large amount of lime, you may choose to apply only enough in each rotation to grow the legume you want. This plan is slightly less effective and may cost more in the long run, but it costs less to start with.

The lime needed to grow legumes in different situations is shown in table 2. On strongly acid soils, an extra ½ to 1 ton would be a good investment for you if your soil is heavier than average.

Young legume seedlings need a suitable pH close to them. Therefore, when you lime a *very acid soil*, you have three choices: (1) apply a large amount of lime *before* plowing and mix through the plow layer; (2) apply part *before* and part *after* plowing; or (3) apply a smaller amount *after* plowing.

Choice number 1 usually means that you lime the sod before plowing the corn. This is a convenient place to apply lime, but more lime is needed than when you apply the lime on the surface after plowing (table 2, *surface or plowed in*).

Choice number 2 is satisfactory if you bulk-spread 2 tons before plowing and then broadcast the remainder at planting time.

Choice number 3 is a way to make a small amount of lime most effective on a strongly acid soil. It helps the legume to get started, but a top-dressing is needed after two or three years for long-lived plants such as alfalfa.

For soils that have been limed in the previous five years with 2 tons of lime, or that were only slightly acid and have received 1 ton, you need to make no special provision for lime close to the seed. You may lime at any convenient time or at any place in the rotation, which usually is on the sod.

Table 2. Liming Recommendations, Department of Agronomy

pH of surface soil	Legume to be grown	Lime to apply per acre			
		Soils with no lime in the subsoil to the depth that roots penetrate		Soils with lime in subsoil within the depth that roots penetrate	
I. LOAMS TO SILTY CLAY LOAMS		*Surface	†Plowed in	*Surface	†Plowed in
5.5 or below Strongly acid	Alfalfa as main legume	2 tons	4 tons	2 tons	3 tons
	Birdsfoot trefoil; ladino, red, or alsike clover Alfalfa only as minor legume in mixture	2 tons	3 tons	1½ tons	2 tons
5.6 to 6.0 Moderately acid	Alfalfa	2 tons	3 tons	1½ tons	2 tons
	Other legumes	1½ tons	2 tons	1 ton	1½ tons
6.1 to 6.5 Slightly acid	Alfalfa	1½ tons	1½ tons	1 ton	1 ton
	Other legumes	Maintenance only (0 to 1 ton)		Maintenance only (0 to 1 ton)	
II. SANDS					
5.5 or below	Alfalfa, ladino clover, or birdsfoot trefoil (long-lived)	2 to 2½ tons			
	Red or alsike clover (short-lived)	1½ to 2 tons			
5.6 to 6.0	Alfalfa, ladino clover, or birdsfoot trefoil (long-lived)	1½ to 2 tons			
	Red or alsike clover, (short-lived)	1 to 1½ tons			
6.1 to 6.5	Alfalfa	1 to 1½ tons			
	Other legumes	Maintenance (0 to 1)			

**Surface* means that the lime is applied on the surface after plowing.

†*Plowed in* means that all or most of the lime is applied before plowing and is therefore distributed through the furrow slice. The field may be plowed once or twice between liming and seeding.

Liming New Seedings

IF you fail to get lime on a field before seeding, you can, *as an emergency measure,* apply it after the small grain is harvested, *provided the legume stand is still good enough* to justify liming. This is positively not recommended for soils that are strongly acid, because the legume seedlings will not even get started.

When to Re-lime

MANY farmers fail to re-lime soon enough. County agricultural agents who have tested soils in the same county for many years report that the average pH is not much higher than it was twenty years ago. Many farmers have used only enough lime to maintain the original pH, but not enough to raise it to the desired level.

While you are building up the pH of your soil, apply lime as outlined in table 2. After a soil has reached the desired pH, 1 ton of lime per acre for a 4-year rotation, or 1½ tons for a 6-year rotation, will maintain the pH. Test the soil again to make sure that the lime is doing the job.

Bulk-spreading

TEN years ago more than 90 per cent of the lime used was spread by farmers. Now at least 75 per cent is bulk-spread for farmers by custom operators. You can get lime bulk-spread on your fields for about the same cost as bagged lime delivered to your farm.

The months when lime is delivered to New York farms is shown in figure 3. Heaviest use is on the seedbed just before planting and in the fall. The seedbed is an efficient place to put lime in the rotation and was satisfactory when farmers spread lime with a sower. Bulk-spreading changes the picture. A newly plowed field or a seedbed is not the best place for an 8- to 10-ton truck.

Figure 3. June, July, and August are the months to order extra lime

Bulk spreaders are best suited for liming meadows, pastures, small-grain stubble, and corn-stubble. Mid-summer is one of the best times to lime meadows and pastures because they are dry and firm. Furthermore, bulk spreaders are easier to get during this period.

Kinds of Liming Materials

Ground limestone is finely ground limestone rock. More than 95 per cent of the lime material used in New York is of this type. It may be either high calcium composed mostly of calcium carbonate, or dolomitic, which includes magnesium carbonate in addition to calcium carbonate. A high-grade limestone analyses at least 90 per cent calcium carbonate equivalent or 50 per cent lime oxide equivalent.

Burned lime is made by burning limestone. This is a concentrated type of lime, but it is caustic and difficult to handle. It is no longer used to lime soils.

Hydrated lime results when burned lime is slaked and takes up water. This form is commonly used by vegetable growers who want an extremely rapid effect and a careful control of soil pH. Recent evidence indicates that the same investment in finely ground limestone is as effective as hydrated lime and lasts longer. Hydrated lime is preferred where you do not want a lasting effect.

Marl is a soft form of limestone that was deposited in swamps under peat or muck. It can be used locally, but is too high in moisture for commercial development.

Supplying Magnesium

MAGNESIUM deficiencies exist in some orchards and in some land used for vegetables. Magnesium is generally recommended for potatoes on acid soils. Research is being continued, but evidence is not available, to show a need to supply extra magnesium for field crops such as corn, oats, wheat, hay, and pasture. *Soil tests show that magnesium is seldom low in a well-limed soil.*

Like calcium limestone, dolomitic limestone neutralizes soil acidity but it also supplies magnesium. When you can buy it at the same price as high calcium limestone, either may be used. On low magnesium soils, you can afford to pay some premium for dolomitic limestone.

Effect of Lime on Other Nutrients

IN an acid soil much of the soil phosphorus, as well as the phosphorus added in fertilizer, is in "cold storage." Lime increases the availability of this phosphorus to plants.

On the other hand, lime reduces the toxicity of manganese, iron, and aluminum which are present in strongly acid soils.

A pH between 6.5 and 7.0 favors the growth of bacteria and other soil organisms that speed the release of nutrients from organic matter and soil minerals.

You need a favorable pH to get a good return from the money you spend for seed and fertilizer (figure 1, page 2).

Overliming

SOILS seldom are overlimed on practical farms. A very acid soil, pH 4.5 to 5.0, that is limed heavily enough at one time to raise the reaction above pH 7.0 may be overlimed. In an average loam soil at pH 5.0, at least 4 tons would be required, and even more in a heavier soil. Over-liming makes some of the minor elements, such as boron, manganese, and iron, less available to plants. There is no danger of overliming if you follow the liming recommendations in table 2.

Leaching

LIME washes slowly down through the soil. At recommended rates of application, leaching is of little practical importance on acid soils of loam texture or heavier. On very sandy soils, lime moves more rapidly. The suggested rates for liming in table 2 take into account these losses.

Lime in the Stable

LIME is not a substitute for superphosphate in the stable. It reduces odor, makes the floor less slippery, and improves the appearance of the stable. Lime does not balance the fertilizer nutrients in manure nor prevent the loss of nitrogen as does superphosphate.

Adding lime to manure is, however, an easy way to get lime on the land. To apply 1 ton of lime per acre, add 2 bags to the top of each load of manure and spread 10 loads to the acre. To apply 2 tons of lime, use 4 bags per load.

Several years ago farmers were advised not to use lime with manure. That warning applied to the use of hydrated lime on rotted manure, and does not apply to the use of ground limestone on fresh manure.

Bulk-Spreading Lime-Fertilizer Mixtures

BULK-SPREADING of superphosphate and lime has been tried on a small scale for several years. Standard chemical tests show a decrease in water-soluble and available phosphorus according to the official test. Probably this is not of practical importance unless you store the mixture for several days or at high temperature. The same reversion occurs when superphosphate is applied to any soil that is high in pH.

A few dealers will bulk-spread lime and mixed fertilizers, such as 0-20-20. The saving of bags about offsets the extra cost of spreading. High-calcium lime should not be mixed with fertilizers containing ammonia forms of nitrogen because the chemical reaction results in loss of nitrogen.

Uniform spreading of lime is always desirable. Even more care must be taken with lime-fertilizer mixtures because the product represents a larger investment.

Coarse or Fine Limestone

MOST agricultural ground limestone sold in New York is finely ground; 98 per cent passes through a 20-mesh screen, and 40 per cent goes through a 100-mesh screen.

Research results clearly show that only fine limestone has real value for crop growth during one or two rotations. In an experiment that ran for 13 years, 1 pound of material 50-mesh and finer was as effective as 4 pounds of 10- to 50-mesh.

Dry or Wet Lime

LIME as it comes from the crusher is dry. Finely ground lime in this condition is dusty and objectionable to handle. Usually farmers do not like to see it blow across their line fence even though the amount is small. For this reason, water is often added to dampen the lime after it is weighed onto the truck. You don't pay for this extra water. You pay for lime on the basis of actual power to raise the pH of your soil.

Liming Records

A RECORD of pH tests and of the lime applied to each field will help you to decide where to use lime each year. Over a period of years the record will show whether you are building the pH of your farm to the most profitable level.

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